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Report 72-1

Army Helicopter Terrain Collision Study

U.S. ARMY BOARD FOR AVIATION ACCIDENT RESEARCH, FT. RUCKER, ALA.
UTILITY/ATTACK DIVISION
AIRCRAFT ACCIDENT ANALYSIS AND INVESTIGATION DEPARTMENT
USABAAR

ARMY HELICOPTER TERRAIN COLLISION STUDY
CY 1969

by
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Utility/Attack Division
Aircraft Accident Analysis and Investigation Department

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THE U.S. ARMY BOARD FOR
USABAAR
AVIATION ACCIDENT RESEARCH

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Director

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I. ABSTRACT. This study contains analyses of 836 Army helicopter collisions with terrain obstacles which occurred during calendar year 1969. It summarizes major cause factors on a worldwide basis and presents recommendations to prevent recurrence of similar type mishaps. This study does not include figures on mishaps attributed to maintenance and/or materiel malfunctions.

II. SUMMARY. The 836 Army helicopter collisions with terrain obstacles resulted in 177 fatalities, 299 injuries, and involved 2,020 individuals, at a dollar loss of $55½ million. Crew error mishaps involved several categories. Most notable of these were 433 tree strikes in Vietnam. Tree strikes occurred during the following phases of flight: hovering–244, landing–239, inflight–160, and a surprisingly low number during autorotations–40. UH-1 and AH-1G helicopters were most frequently involved, accounting for 611 mishaps. Most mishaps occurred in Vietnam during daylight hours on combat missions. Prevention of helicopter terrain collisions requires competent training; enforced flight discipline; better planning; management of facilities, including selection and preparation of landing and pickup zones, revetment placement, etc.; and ground handling of helicopters in confined areas.

CONSOLIDATION OF WORLDWIDE MISHAPS

	NUMBER	PERCENT
Mishaps	836	
Major accidents or aircraft losses	278	33
Personnel involved	2,020	
Injuries	299	15
Fatalities	177	9
Crew error mishaps	764	91
Cost of mishaps	$55,689,788	

Corrective actions to prevent these mishaps taken by commands and/or units in which these aircraft were assigned consisted mainly of the following:

1. Daily and monthly safety meetings and briefings, discussing particulars of each mishap.
2. Primary flight training manuals reviewed and revised as necessary.
3. Flight standardization boards monitoring checkrides and transition training to preclude operational problems concerning aircraft flight characteristics and emergency procedures.
4. Emphasis placed on compliance with training procedures, effects of high density altitude, and weather conditions.
5. Reviewing of aviator proficiency requirements, aviator flight briefings, and supervision techniques.
6. Conducting training classes and supplementing local SOP's as necessary.

III. INTRODUCTION. This study was initially confined to utility/attack helicopters. However, after analysis revealed the magnitude of terrain collisions, the decision was made to expand the study to include all helicopters in the Army inventory. This decision was based on Army statistics revealed by preliminary analysis. For example, it was found that only two type helicopters (UH-1 and AH-1) were involved in 611 terrain collisions during 1969, accounting for the loss of 148 lives and a dollar loss of $43 million. As the title implies, this study is broad in scope and includes collision with trees, stumps, revetments, parked aircraft, wires, and other terrain obstacles. Crew error was suspected of being a leading cause factor for terrain collisions prior to the beginning of this study. However, the extent to which crew error was involved far exceeded expectations. Of the 836 terrain collision mishaps studied, crew errors were involved in 764, or 91 percent, of the mishaps. Four of these crew error mishaps were due to faulty internal communications between crewmumbers during landings in LZ's. Analysis of these mishaps is divided into three sections:

utility/attack (Annex A), LOH (Annex B), and cargo (Annex C) helicopters.

IV. CONCLUSIONS. The corrective recommendations listed may appear to be stereotyped. They have, nonetheless, been deemed as appropriate actions taken by the highest forwarding headquarters. Therefore, it must be assumed by USABAAR that these actions have been taken. These types of mishaps have recurred in the same organizations. This is particularly true for tree strike mishaps, due in many cases to ground commanders not properly preparing LZ's. However, this does not relieve aircraft commanders of the responsibility for conducting safe flights in accomplishing their missions. In some cases, commanders have been accepting these mishaps as necessary losses for mission accomplishment. Also, since the majority of these tree strikes resulted in incident damage, they did not affect the accident rate. Since recurrences happen, it appears that corrective actions taken and approved are ineffective.

The crew error figures may seem high to some and low to others, as a study of this nature involves an aircraft literally being flown into some object. However, whether or not you think these figures are high or low, the main point is that crew error mishaps can be prevented by concerted efforts of all Army aviators. Something has to be done. After all, 91 percent of the 836 mishaps during this period were attributed to crew error. Although commanders can place emphasis on this subject, they cannot fly every mission. The answer to the crew error problem is that *all aviators* must make an all-out effort to prevent terrain collision mishaps. Let's take a look at some of the agents that help induce crew error:

1. Complacency
2. Fatigue
3. Poor pilot technique
4. Mission requirements
5. Environment
6. Supervision

There are other means of inducing crew error, but these six appeared most frequently in this study. It would be more appropriate to view these six inducements to crew error independently.

Complacency–a feeling of content and satisfaction, especially self-satisfaction and smugness. These conditions can be produced in long and repeated missions, usually following the same routes in the same type aircraft. A complacent condition develops in most cases with the crew being completely unaware that they are victims of this condition. Consequently, they are not as alert to flying the mission as the mission dictates, resulting in mishaps.

Fatigue–the condition of being very tired as a result of physical or mental exertion, weariness, or exhaustion. This condition most certainly exists in RVN, and perhaps in other areas as well. It is closely associated with complacency and renders a crew almost incapable of properly performing their mission. There have been times when fatigue has approached such a level that a normal 8 hours of sleep would not restore the individual to his top level of performance. Dog-tired flight crews are poor substitutes for safe flight operations and most probably result in more mishaps than realized.

Technique–the manual or bodily skills necessary to accomplish some end or result, the technique of a pianist or a pilot. Poor pilot technique appears in many ways, from sloppy or unplanned flight maneuvers to placing an aircraft in a condition from which it exceeds the designed aerodynamic limits. Several examples of this would be steep gunruns with late recoveries and major flight control input in an effort to pull out of a dive, resulting in a combination of high sink rate and weight that exceeds the lift capability of the rotor system. On steep climbing turns, a major flight control input will bleed off rpm to the extent that forces of the rotor system are no longer effective. This results in mishaps.

Mission requirements–that which is required; a requisite; the act of requiring; a demand. It is well known that most missions are planned at high staff levels and in some cases controlled by tactical ground commanders and passed on to operational aviation units for execution. These operations create many problems for lower level operational aviation commanders. In many cases, there is only time for rapid attempts to execute requirements, without time to properly and safely plan missions at the lower level prior to attempt-

ing execution. Results are tree strikes, revetment strikes, striking parked aircraft, etc. It would certainly behoove major commanders to look into this area, as it is probably responsible for the larger number of mishaps.

Environment–the aggregate of external circumstances, conditions, and things that affect the existence and development of an individual, organism, or group. The environment in which the missions are flown is extremely important. This is particularly true in RVN. In some cases, mission requirements in RVN place a crew at an altitude best described as the grey area. Any type of emergency requires immediate application of appropriate procedures to prevent a mishap or catastrophe. These type missions tax the alertness and professionalism of crews, and such things as complacency, fatigue, or poor pilot technique cannot exist if mishaps are to be prevented. It is obvious that this environment must be accepted to accomplish the mission. It is also obvious this type mission requirement is not going to change if the job is to be accomplished. This shifts the burden to aviation unit commanders to insure that mission assignments go to the best qualified crews available.

Supervision–the act of supervision; superintendance; the authority to supervise. Thirty-two mishaps which occurred during this period were attributed to command supervision. These included selection of unqualified crews for missions; poor preparation of LZ's; poor POL facilities; failure to conduct adequate briefings; etc. Once again, it is the commander who is responsible, and it is he who must initiate the correct action necessary to prevent mishaps in this area.

As stated before, the six areas discussed were by no means the only cause factors for all the mishaps included in this study. But they were the most predominate. All six of these cause factors can be corrected by concerted efforts of all Army aviators.

V. RECOMMENDATIONS. Increased command emphasis on:

1. Unit training in collision avoidance, including full crew coordination and assigned responsibilities for each crewmember.
2. Enforced flight discipline to prevent low level flying when it is unnecessary for mission accomplishment.
3. Improved planning and preparation of landing and pickup zones.
4. Improved planning in the placement and construction of revetments and other obstacles which might prove hazardous in and around heliports and airfields.
5. A requirement to ground handle helicopters in confined areas.
6. Removal of unwarranted obstacles in areas of frequent operation.

APPENDIX A
UTILITY/ATTACK AIRCRAFT
"COLLISION WITH TERRAIN"
MISHAPS
(1 Jan 1969 - 31 Dec 1969)

MISHAP CLASSIFICATION	UH-1	AH-1G	TOTAL
Major accidents	149	31	180
Minor accidents	9	3	12
Incidents	396	23	419
TOTAL	**554**	**57**	**611**
MISHAP LOCATION			
CONUS	34	3	37
Europe	1	0	1
RVN	515	54	569
Other	4	0	4
TYPE OBJECT AIRCRAFT STRUCK			
Tree	326	11	337
Terrain	99	28	127
Revetment	42	18	60
Stump	63	0	63
Wire	24	0	24
Other	0	0	0
PHASE OF OPERATION IN WHICH MISHAP OCCURRED			
Inflight	79	18	97
Hover	169	15	184
Landing	196	8	204
Takeoff	98	10	108
Autorotation	12	6	18
MISSIONS FLOWN			
Training	32	8	40
Service	30	3	33
Test	16	1	17
Combat	476	45	521
PERSONNEL			
Involved	1539	91	1630
Injuries	186	17	203
Fatalities	148	4	152
PERIOD OF DAY			
Daylight	486	44	530
Night	48	10	58
Dusk	17	2	19
Dawn	3	1	4

	UH-1	AH-1G	TOTAL
MISHAP CAUSE FACTOR			
Operation (Crew error)	499	48	547
Command supervision	20	7	27
Facilities	30	2	32
Unknown	5	0	5
MISHAP COST*			
Major accidents	$26,700,000	$6,102,000	$32,802,000
Minor accidents	100,000	49,000	149,000
Incidents	10,000,000	99,000	10,099,000
TOTAL	**$36,800,000**	**$6,250,000**	
GRAND TOTAL			**$43,050,000**

**Figures have been rounded off to nearest $1,000.*

APPENDIX B
LOH AIRCRAFT
"COLLISION WITH TERRAIN"
MISHAPS
(1 Jan 1969 - 31 Dec 1969)

MISHAP CLASSIFICATION	OH-6	OH-23	TH-55	OH-13	TOTAL
Major accidents	63	7	12	7	89
Minor accidents	1	2			3
Incidents	61	24	7	8	100
TOTAL	**125**	**33**	**19**	**15**	**192**
MISHAP LOCATION					
CONUS	1	30	19	12	62
Europe				1	1
RVN	124	1			125
Other		2		2	4
TYPE OBJECT AIRCRAFT STRUCK					
Tree	49	20	2	7	78
Terrain	25	4	13	6	48
Revetment	9				9
Stump	5	2			7
Wire	3				3
Other	34	7	4	2	47
PHASE OF OPERATION IN WHICH MISHAP OCCURRED					
Inflight	49	2	3	3	57
Hover	23	11	5	4	43
Landing	22	7	4	1	34
Takeoff	15	9	1	5	30
Autorotation	12	3	5	2	22
Static	4	1	1		6

	OH-6	OH-23	TH-55	OH-13	TOTAL
MISSIONS FLOWN					
Recon	45				45
Support	29				29
Training	13	22	19	10	64
Assault	12				12
Service	9	10			19
Medical evacuation	5			4	9
Command/control	5	1			6
Resupply	4				4
Troop extraction	2				2
Other	1			1	2
PERSONNEL					
Involved	230	40	23	18	311
Injuries	63	2	3	4	72
Fatalities	12	2	2	1	17
PERIOD OF DAY					
Daylight	113	32	16	11	172
Night	5		3	2	10
Dusk	5	1		2	8
Dawn	2				2
MISHAP CAUSE FACTOR					
Operation	121	33	18	14	186
Command supervision	2		1		3
Facilities	1				1
Unknown	1			1	2
ENVIRONMENTAL CONDITION					
Wind	12	4			16
Wind gust	5				5
Low ceiling	2			2	4
Sun glare	2				2
Fog	1				1
Smoke	1				1
Rain	1				1

MISHAP COST	**OH-6**	**OH-23**	**TH-55**	**OH-13**	**TOTAL**
Major accidents	$4,545,694	$280,966	$190,111	$196,106	$5,212,877
Minor accidents	3,262	6,227			9,489
Incidents	96,442	24,330	8,713	9,182	138,667
TOTAL	**$4,645,398**	**$311,523**	**$198,824**	**$205,288**	**$5,361,033**

APPENDIX C
CARGO AIRCRAFT
"COLLISION WITH TERRAIN"
MISHAPS
(1 Jan 1969 - 31 Dec 1969)

	CH-47	CH-34	CH-37	CH-54	TOTAL
MISHAP CLASSIFICATION					
Major accidents	5	4			9
Minor accidents					0
Incidents	21	2		1	24
TOTAL	**26**	**6**	**0**	**1**	**33**
MISHAP LOCATION					
RVN	21				21
CONUS	5	2		1	8
Europe		4			4
Other					0
TYPE OBJECT AIRCRAFT STRUCK					
Tree	15	3			18
Terrain	10	2			12
Revetment	1				1
Wire				1	1
Other		1			1
PHASE OF OPERATION IN WHICH MISHAP OCCURRED					
Static					0
Taxi				1	1
Takeoff	5	2			7
Inflight		1			1
Landing	6				6
Ground	1				1
Autorotation					0
Hover	14	3			17
PERSONNEL					
Involved	63	24		2	89
Injured	20	4			24
Fatalities	8				8
PERIOD OF DAY					
Day	26	6			32
Night				1	1
Dusk					0
Dawn					0
MISHAP CAUSE FACTOR					
Operation	24	6		1	31
Command supervision	2				2
Facilities					0
Unknown					0

	CH-47	CH-34	CH-37	CH-54	TOTAL
ENVIRONMENTAL CONDITION					
Snow		1			1
Turbulence	1	2			3
Clouds/Fog	1	1			2
Density/Altitude	2				2
Unknown/Not a Factor	22	2		1	25
MISSION FLOWN					
Service	2	3			5
Test				1	1
Transporting/Personnel		3			3
Combat Support	13				13
Resupply	2				2
Combat Assault	3				3
Training	4				4
Medical Evacuation	1				1
Troop Extract	1				1
MISHAP COST					
Major	$6,159,203	$842,746			$7,001,949
Incidents	272,683	2,755		$358	275,796
TOTAL	**$6,431,886**	**$845,501**	**$0**	**$358**	**$7,277,745**

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